Simulations of Global-Scale Dynamo Action and Magnetism in Rapidly Rotating Suns

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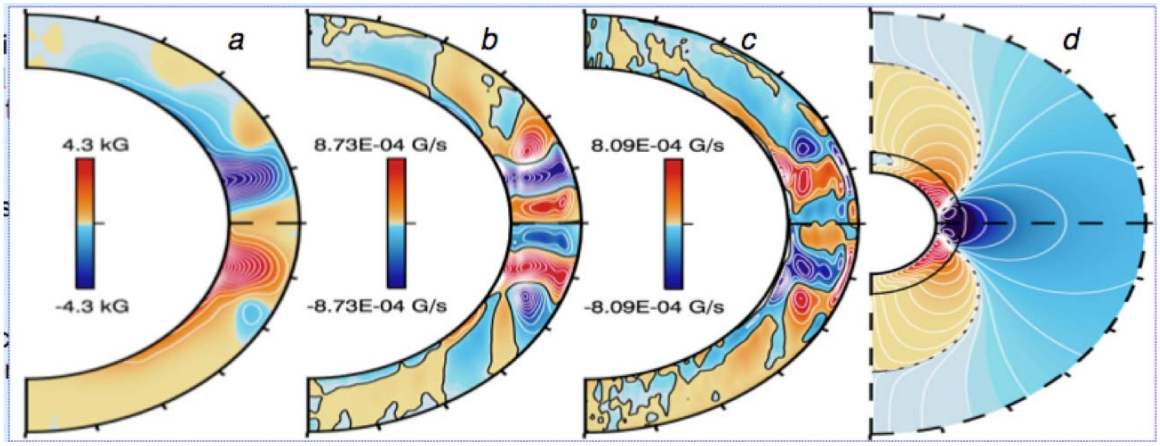
Early in its life our sun rotated much more rapidly. Observations of young, rapidly rotating stars indicate that magnetic activity and possibly dynamo action are stronger with more rapid rotation. 3-D simulations of compressible MHD turbulent convection are carried out with the anelastic spherical harmonic (ASH) code on massively parallel supercomputers. Continuing earlier HTP work on rapidly rotating suns, dynamo action was explored in a simulation of a younger sun rotating at three times the current rate. A striking finding is that coherent magnetic structures arise in the midst of the turbulent convection zone. These wreathes of toroidal field persist for long periods of time. There is a complex balance between the strong differential rotation which rebuilds the wreathes and the turbulent convection that shreds them apart and sweeps them into other portions of the convection zone.



Mean profiles of (a) B_Φ and magnetic production terms from (b) differential rotation which maintains the wreathes and (c) turbulent shear and advection, which act to disassemble them. (d) Extrapolation of poloidal magnetic field to 3 R_*, with polarity indicated by color.

Reference: Brown, B., Browning, M., Brun, A.S., Miesch, M. & Toomre, J. 2008a, "Rapidly rotating suns and active nests of convection", ApJ, in press and on Astro-ph.